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ABSTRACT

Two basic methods exist for drawing probability samples to be used in telephone surveys: directory sampling (from alphabetical or street directories) and random digit dialing (RDD). RDD includes unlisted numbers, whereas directory sampling includes only listed numbers. The goal of this paper is to estimate the effect of failure to include unlisteds in the sample on survey results. Two community-wide telephone surveys were conducted for the Sacramento City Zoo (California) (N=100) and for Sacramento Department of Parks and Community Services (N=429), using the pure RDD method. Data analyses were conducted using the chi-square statistic as run on SPSS/PC+. Results showed responses to four questions exhibited significant listed-unlisted differences. There was evidence that researchers using listed RDD samples might come to different conclusions, but the evidence was not strong. Although the research presented here is clearly limited (reports on a single and fairly narrow geographic area, concerns only two surveys addressing related topics, and contains one survey with a small sample size), it suggests that survey results may depend on sampling technique. Additional inquiry is warrented for a more definitive assessment. (BAE)

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Sampling for Telephone Surveys: Do the Results Depend on Technique?

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Introduction

Two basic methods exist for drawing probability samples to be used in telephone surveys: directory sampling (from alphabetical or "criss-cross" [street] directories; and random digit dialing (RDD). The latter, Cooper's (1964) "ingenious method" as it was described by Perry (1968), was developed in order to eliminate the presumed biases inherent in directory samples. Ever since then, controversy has raged over whether such biases in fact exist, how severe they are, and the extent to which they are likely to affect actual survey responses. Central to the controversy is the issue of whether the increased cost associated with the implementation of RDD samples is warranted by any increase in precision they might afford.

That RDD samples have substantial cost implications relative to directory samples is not a subject of debate. The reason for the added cost, quite simply, is that pure RDD samples contain large proportions of nonworking or nonexistent numbers. Because these numbers cannot be identified in advance of sample implementation, interviewers must expend considerable time on fruitless dialings (Cummings, 1979; Waksberg, 1978). Several modifications of RDD have been proposed, but none fully overcome the nonworking number problem, and all have offsetting methodological problems (Dillman, 1978; Glasser and Metzger, 1972; Groves, 1978; Groves and Kahn 1979; Sudman, 1973; Waksberg, 1978).

Further complications arise in the use of RDD because it is impossible accurately to calculate response or refusal rates for such samples. Because the system of recordings used by the telephone company to notify the caller of nonworking, disconnected, or nonexistent numbers is at best imperfect, the researcher can never be certain whether a never-answered number represents a "non-number" or a not-at-home. While this situation has no direct cost implications, it can place the researcher in a position of methodological unease sufficient to cause consternation on the part of the research consumer. To the extent that the findings lose credibility as a result, certain social costs may plausibly be inferred.

Given the costs associated with RDD, both financial and (at least potentially) social, the question arises whether the additional investment in RDD is worthwhile. Are there in fact biases in directory samples? If so, how severe are they and, more important, what potential do they have to affect survey responses?

The demographic biases of directory samples have been fairly well demonstrated. Although the research is not completely uniform relative to the directionality of the biases, study after study has shown that those who are not listed in directories - and particularly those who are voluntarily unlisted - are significantly different from those who are listed. Dimensions

that have been documented include age, ethnicity, income, educational level, presence of a spouse, presence of children, type of household (rental vs. owner-occupied), and region of the country (Blankenship, 1977; Brunner and Brunner, 1971; Glasser and Metzger, 1972 & 1975; Groves, 1978; Kviz, 1978; Leuthold and Scheele, 1971; Rich, 1977; Tull and Albaum, 1977).

Insofar as the severity of the biases is concerned, however, consensus has been more difficult to achieve. The differences between listeds and unlisteds tend to be statistically significant, and their magnitude is frequently substantial. Their contribution to the total response, on the other hand, may be relatively minor (Rich, 1977). Rich has concluded that unless known demographic differences between listeds and unlisteds can be expected to influence the results, RDD is not worth the cost. (How the researcher might realistically develop such an expectation a priori is, however, not specified.) Conversely, Blankenship (1977:42) has argued that "the only dependable sample" is an RDD one.

In a paper presented at last year's American Educational Research Association Annual Meeting, Anderson (1976:5-6) argued that following the Blankenship contention was more "trendy" than supported by the available evidence. Specifically, he wrote:

> Therefore, the focus of concern for survey researchers should be not whether households with telephones differ from those without telephones or whether those with or

> without published listings differ, but, rather, whether the total sample results differ when such groups are included or not included in the sample. In most studies, the percentage of sample that are in these two groups will be small and have little effect on the survey results. Studies designed to examine the size of such effects have found that, while differences between these groups and other respondents may be statistically significant the effect they have on changing the overall survey results is small -- often 2% or less.
>
> Obviously, these results should not be interpreted to mean that one need never worry about bias caused by households without telephones or with unpublished telephone numbers. In some studies an error of 1% or 2% or less may not be tolerable, or in studies of certain segments of a population such as very low income groups many people may not have telephones and the effect may be large. Decisions as to the necessity of using random digit dialing procedures must be made for each study. However, it does appear that survey researchers need not uniformly adopt random digit dialing procedures for all telephone studies.

It is the contention of this paper that critical evidence in support of Anderson's position has been missing. None of the studies he cited, nor any others this author has been able to identify, has assessed the impact of listeds versus unlisteds on actual survey **results**. Rather, the focus has been exclusively on the **demographic characteristics** of listeds and unlisteds and the fact that the elimination of unlisteds from the sample does not appear substantially to alter the demographic composition of the total.

The goal of this paper is to estimate the effect of failure to include unlisteds in the sample on survey **results**. Although the research presented here is limited in scope and additional study

is clearly called for, the preliminary conclusion is that actual results may be substantially dependent upon the sampling method selected.

Approach

The data presented in this paper derive from two community-wide telephone surveys conducted during 1986 in the vicinity of Sacramento County, California. Samples for the surveys were develop using the pure RDD method, as follows:

___ ___ ___ - ___ ___ ___ - ___ ___ ___ ___

Area Code (Known) | Central Office Code (Known) | Random Digits (Computer-Generated)

Total completions for the surveys were n = 100 for a master planning study on behalf of the Sacramento City Zoo and n = 429 for an evaluation of the Activity Guide published by the City of Sacramento's Department of Parks and Community Services. Results of calling for the two surveys are presented in Figures 1 and 2 on pages 6 and 7.

In each of the surveys, the last question asked of respondents was a pure research question designed to gather the data necessary for the preparation of this paper. It inquired, "Could your tell me whether your telephone number listed or unlisted?"

FIGURE 1

RESULTS OF CALLING: ZOO SURVEY

TOTAL NUMBERS DIALED ONE OR MORE TIMES			740
Less:			
Numbers Not Assigned or Not Working	= 247		
Business Numbers	= 48		
Numbers Not In Target Population		300	
(E.g., Not In City, Pay Phones, Motels)	= 5		
Equals:			
Potentially Usable Numbers			440
Less:			
Numbers At Which There Was No Contact At Up To Three Attempts:			
No Answer, Busy Signal, Answering Machine	= 293		
No Adult At Home	= 15		
Communication Barrier		309	
(Foreign Language; Hearing Impaired)	= 1		
Equals:			
Numbers At Which Contact Was Made			131
Less:			
Callbacks Unavailable Later	= 10		
Refusals	= 20	31	
Interviews Terminated In Progress	= 1		
Equals:			
COMPLETED INTERVIEWS			100

Completion Rate 1[a]	23%	Refusal Rate 1	5%
Completion Rate 2[b]	76%	Refusal Rate 2	15%

[a] Percentage of Potentially Usable Numbers

[b] Percentage of Contacts

FIGURE 2

RESULTS OF CALLING: ACTIVITY GUIDE SURVEY

TOTAL NUMBERS DIALED ONE OR MORE TIMES			1,966
Less:			
Numbers Not Assigned or Not Working	= 712		
Business Numbers	= 242		
Numbers Not In Target Population		1,017	
(E.g., Not In City, Pay Phones, Motels)	= 63		
Equals:			
Potentially Usable Numbers			949
Less:			
Numbers At Which There Was No Contact At Up To Three Attempts:			
No Answer, Busy Signal, Answering Machine	= 322		
No Adult At Home	= 4		
Communication Barrier		352	
(Foreign Language; Hearing Impaired)	= 26		
Equals:			
Numbers At Which Contact Was Made			597
Less:			
Callbacks Unavailable Later	= 6		
Refusals	= 118	156	
Interviews Terminated In Progress	= 32		
Equals:			
COMPLETED INTERVIEWS			441

Completion Rate 1[a]	47%	Refusal Rate 1	16%
Completion Rate 2[b]	74%	Refusal Rate 2	26%

[a] Percentage of Potentially Usable Numbers

[b] Percentage of Contacts

Other questions used for the analyses presented here were selected on the basis of their importance to the research consumer, or client. For each study, the six questions the client deemed most critical and useful were subjected to further analysis. These questions were as follows:

Zoo Master Plan Survey

. Has anyone in your household visited the Sacramento Zoo in the past two years?
. Has anyone in your household visited Fairytale Town in the past two years?
. From what you have personally seen or heard, how would you rate the Sacramento Zoo in comparison to other public recreation facilities in California?....Would you say that it is excellent, good, fair, or poor in comparison?
. Now I would like to know how you feel about some suggestions that have been made for changes in William Land Park and the Zoo. As I read each one, please tell me whether you strongly favor it, favor it, oppose it, or strongly oppose it. Here is the first one... START WITH STATEMENT CHECKED. (Do you strongly favor, favor, oppose, or strongly oppose this suggestion?)
. Expand the Zoo to an area next to it in the park.
. Now I would like you to consider some suggestions that

have been made about the future financial support of the Zoo. As I read each one of these suggestions, please tell me again whether you strongly favor, favor, oppose, or strongly oppose it. Here is the first one ... START WITH STATEMENT CHECKED. (Do you strongly favor, favor, oppose, or strongly oppose this suggestion?)

. Pass a bond issue specifically for the Zoo

. Try to get financial support from private corporations

Activity Guide Survey

. Did you receive the Summer Activity Guide from the City's Department of Parks and Community Services?

. Did you or anyone else in your household read any part of the Activity Guide?

. Are there any activities that you or other members of your household are planning to participate in as a result of reading the Guide?

. Would you (he)(she)(they) have planned to do these things even if you (he)(she)(they) hadn't received the Activity Guide?

. Have you or other members of your household ever gone to the Sacramento Zoo?

. Have you or other members of your household ever visited

Data analyses were conducted using the chi square (x^2) statistic as run on SPSS/PC+. Where appropriate, Yates Corrections are automatically performed by the software.

Findings

Table 1 on page 11 shows the distribution of the two respondent groups by reports of listed and unlisted telephone numbers. Both distributions are within the expected range for the Sacramento area, which is reassuring given that the Zoo sample was unfortunately small.

Differences between the answers of the listed and unlisted respondents to the six selected Zoo survey questions are portrayed in Tables 2 through 7 on pages 11 to 14. Although most of these tables do not display any statistically significant differences ($p<.05$), the one concerning expansion of the Zoo does, and the one relative to Fairytale Town visits would have had the Yates Correction not been applied. Moreover, both of these differences have the potential for substantial practical import. The case of Zoo expansion is particularly critical, as this issue has been heatedly contended and involves considerable political controversy.

TABLE 1
PROPORTION OF RESPONDENTS WITH LISTED AND UNLISTED TELEPHONE NUMBERS

Survey	Listed		Unlisted	
	n	%	n	%
City Zoo	64	64.0%	36	36.0%
Activity Guide	259	60.4%	170	39.6%

TABLE 2
EXTENT TO WHICH RESPONDENTS HAVE VISITED THE ZOO BY TYPE OF TELEPHONE NUMBER

Response	Listed Number	Unlisted Number
Yes	83.3%	96.3%
No	16.7%	3.7%
Totals	100.0%	100.0%

x^2 = 1.48 (Yates Correction); df = 1; p = .22.

TABLE 3
EXTENT TO WHICH RESPONDENTS HAVE VISITED FAIRYTALE TOWN BY TYPE OF TELEPHONE NUMBER

Response	Listed Number	Unlisted Number
Yes	41.7%	69.2%
No	58.3%	30.8%
Totals	100.0%	100.0%

$x^2 = 3.57$; df = 1; p = .06. (Yates Correction).
$x^2 = 4.61$; df = 1; p = .03. (Before Yates Correction).

TABLE 4
EVALUATION OF THE ZOO BY TYPE OF TELEPHONE NUMBER

Response	Listed Number	Unlisted Number
Excellent	28.1%	33.3%
Good	50.9%	42.4%
Fair	19.3%	24.2%
Poor	1.8%	-
Totals	100.1%	99.9%

$x^2 = 1.33$; df = 3; p = .72.

TABLE 5
EXTENT TO WHICH RESPONDENTS SUPPORT
EXPANSION OF THE ZOO BY TYPE OF
TELEPHONE NUMBER

Response	Listed Number	Unlisted Number
Strongly Favor	36.2%	40.6%
Favor	60.3%	37.5%
Oppose	3.4%	12.5%
Strongly Oppose	-	9.4%
Totals	99.9%	100.0%

$x^2 = 10.14$; df = 3; p = .02.

TABLE 6
EXTENT TO WHICH RESPONDENTS SUPPORT
A ZOO BOND ISSUE BY TYPE OF TELEPHONE NUMBER

Response	Listed Number	Unlisted Number
Strongly Favor	21.4%	22.6%
Favor	41.1%	58.1%
Oppose	28.6%	19.4%
Strongly Oppose	8.9%	-
Totals	100.0%	100.1%

$x^2 = 4.67$; df = 3; p = .20.

TABLE 7
EXTENT TO WHICH RESPONDENTS SUPPORT EXPANSION OF THE ZOO TAX BASE BY TYPE OF TELEPHONE NUMBER

Response	Listed Number	Unlisted Number
Strongly Favor	24.5%	5.9%
Favor	45.3%	47.1%
Oppose	24.5%	44.1%
Strongly Oppose	5.7%	2.9%
Totals	100.0%	100.0%

$x^2 = 6.99$; $df = 3$; $p = .07$.

Insofar as the **Activity Guide** survey is concerned, the situation is somewhat less categorical, as Tables 8 through 13 on pages 15 to 17 indicate. Only two of the variables achieve statistical significance at the $p = .05$ level, and then only if the Yates Corrections are not applied. Moreover, in only one case (pursuit of activities listed in the **Activity Guide**) are the differences substantial, although these data also happen to constitute the foundation for the study's key conclusion.

TABLE 8
EXTENT TO WHICH RESPONDENTS RECEIVED
THE ACTIVITY GUIDE BY TYPE OF TELEPHONE NUMBER

Response	Listed Number	Unlisted Number
Yes	60.2%	54.5%
No	39.8%	45.5%
Totals	100.0%	100.0%

x^2 = .89; df = 1; p = .34 (Yates Correction).

TABLE 9
EXTENT TO WHICH PEOPLE IN RESPONDENTS' HOUSEHOLDS
READ THE ACTIVITY GUIDE BY TYPE OF TELEPHONE NUMBER

Response	Listed Number	Unlisted Number
Yes - Respondent	46.7%	57.9%
Yes - Respondent and/or Others	15.6%	11.8%
No - No One	37.8%	30.3%
Totals	100.1%	100.0%

x^2 = 2.46; df = 2; p = .29.

TABLE 10
EXTENT TO WHICH RESPONDENTS PLANNED TO PURSUE AN ACTIVITY LISTED IN THE ACTIVITY GUIDE BY TYPE OF TELEPHONE NUMBER

Response	Listed Number	Unlisted Number
Yes	36.6%	55.6%
No	63.4%	44.4%
Totals	100.0%	100.0%

x^2 = 3.28; df = 1; p = .07 (Yates Correction).
x^2 = 4.01; df = 1; p = .05 (Before Yates Correction).

TABLE 11
EXTENT TO WHICH RESPONDENTS' PLANS WERE INFLUENCED BY THE ACTIVITY GUIDE

Response	Listed Number	Unlisted Number
Made Plans Due to Activity Guide	60.0%	36.0%
Would Have Made Plans Anyway	28.0%	52.0%
Made Some Plans Due to Activity Guide; Would Have Made Other Plans Anyway	12.0%	12.0%
Totals	100.0%	100.0%

x^2 = 3.30; df = 2; p = .19.

TABLE 12
EXTENT TO WHICH RESPONDENTS HAVE VISITED
THE ZOO BY TYPE OF TELEPHONE NUMBER
(**Activity Guide** Survey)

Response	Listed Number	Unlisted Number
Yes	62.9%	65.9%
No	37.1%	34.1%
Totals	100.0%	100.0%

x^2 = 0.27; df = 1; p = .60 (Yates Correction).

TABLE 13
EXTENT TO WHICH RESPONDENTS HAVE VISITED
FAIRYTALE TOWN BY TYPE OF TELEPHONE NUMBER
(**Activity Guide** Survey)

Response	Listed Number	Unlisted Number
Yes	57.5%	67.1%
No	42.5%	32.9%
Totals	100.0%	100.0%

x^2 = 3.54; df = 1; p = .06 (Yates Correction).
x^2 = 3.93; df = 1; p = .05 (Before Yates Correction).

As Rich and Anderson have point out, however, it is not the differences between listeds and unlisteds *per se* that is critical, but rather the extent to which the total response would be altered were only listeds to be surveyed. This fundamental question is addressed in Tables 14, 15, 16, and 17 on pages 18, 19, and 20, in which listed and total responses for the four questions that exhibited significant listed-unlisted differences at or about the p = .05 level are compared.

TABLE 14
LISTED AND TOTAL RESPONSES CONCERNING
VISITS TO FAIRYTALE TOWN
(Zoo Survey)

Response	Listed	Total
Yes	41.7%	53.2%
No	58.3%	46.8%
Totals	100.0%	100.0%

TABLE 15
LISTED AND TOTAL RESPONSES
CONCERNING SUPPORT FOR EXPANSION
OF THE ZOO

Response	Listed	Total
Strongly Favor	36.2%	37.8%
Favor	60.3%	52.2%
Oppose	3.4%	6.7%
Strongly Oppose	-	3.3%
Totals	99.9%	100.0%

TABLE 16
LISTED AND TOTAL RESPONSES
CONCERNING PLANS TO PURSUE AN ACTIVITY

Response	Listed	Total
Yes	36.6%	44.0%
No	63.4%	56.0%
Totals	100.0%	100.0%

TABLE 17
LISTED AND TOTAL RESPONSES
CONCERNING VISITS TO FAIRYTALE TOWN
(**Activity Guide** Survey)

Response	Listed	Total
Yes	57.5%	63.9%
No	42.5%	36.1%
Total	100.0%	100.0%

With n = 100, responses to the Zoo survey have a tolerance interval of +/- 9.8% (95% confidence level); the listed subsample has a tolerance interval of +/- 12.3% (n = 64). Given these tolerances, it is clear that the researcher evaluating the Zoo survey data (Tables 14 and 15) would not come to conclusions any different from those obtained by a researcher using the data derived from listeds only.

Responses to the **Activity Guide** survey on the other hand, have a tolerance interval of +/- 4.8%; the listed subsample has a tolerance interval of +/- 6.1%. At these considerably smaller tolerance intervals, the researcher working with listed **Activity Guide** data only may come to somewhat different conclusions than

the researcher working with the total sample, although one must concede that the differences are unlikely to be of substantial import.

Conclusions

Numerous researchers have assessed the differences between listeds and unlisteds insofar as the demographic characteristics of telephone survey samples are concerned and have concluded that although these differences are often substantial and frequently significant, they do not appear to have a sufficient effect on survey outcomes to warrant the routine utilization of random digit dialing. In this paper, an effort has been made to estimate the effect of listed - unlisted differences on actual survey responses.

Response differences between listeds and unlisteds can also be substantial, and some are statistically significant. The extent to which they can lead to variable results, however, is somewhat more problematic. There is evidence that researchers using listed and RDD samples might come to different conclusions, but the evidence is not strong.

The research presented here is clearly limited. It reports on a single and fairly narrow geographic area, it concerns only two surveys that address related topics, and it contains one survey

with a regrettably small sample size. Further, given the forum in which this paper is being presented, it does not consider the main topic of concern, namely education. Only with additional inquiry will the paper's contention receive a more definitive assessment. Given the data at hand, however, such an assessment appears warranted. Although the evidence is incomplete, it does suggest that telephone survey results may depend on sampling technique.

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